

METHOD AND DEVICE FOR PROVIDING A SUBSTRATE WITH A COATING LAYER OF A POLYMERIC MATERIAL

TECHNICAL FIELD

5 The present invention relates to a method and a device for providing a substrate with a coating layer of a polymeric material. The invention has especially been developed for, but is not limited to, the coating of a packaging laminate with a polymer layer.

10 PRIOR ART

 The coating of a web-shaped substrate, such as a packaging laminate, with a layer of polymeric material, is performed commercially by extrusion of a polymer layer onto the substrate or by coating the substrate with a dispersion or solution of a polymeric material. The polymer layer may
15 have the function of a barrier layer, against penetration of gas or liquid, a sealing layer etc.

 Even though the today known methods of extrusion and coating are functioning well, there are drawbacks of such techniques. Of all known drawbacks, only a few will be mentioned in the following. By such
20 techniques, it is e.g. difficult to coat parts of the surface of the substrate or to coat non-uniform surfaces or surfaces in different planes. Furthermore, the known techniques require that the polymeric material that during its manufacturing has taken a pulverous form, is processed by e.g.
25 granulation, which means that the original properties of the polymer are affected, often in a negative way. By the known techniques, it is also difficult to be able to apply a very thin coating layer.

BRIEF SUMMARY OF THE INVENTION

 The present invention aims at providing an alternative technique of
30 coating a substrate with a coating layer of a polymeric material. The invention also aims at providing such an alternative technique by which the above mentioned drawbacks of known techniques are overcome or at least diminished. The invention aims primarily at providing such a technique for coating a substrate for a packaging laminate, especially for packaging of
35 liquid foods, with a polymeric material.

 These and other objectives are achieved by the invention as defined in the claims.

 Hence, the method according to the invention relates to a method of providing a substrate with a coating layer of a polymeric material, comprising the steps that:
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- a) a pulverous, polymeric material is suspended in a fluid,
- b) the fluid is pressurised,
- c) the pressurised suspension is ejected onto the substrate to form the coating layer,
- 5 d) the polymeric material is, during any one of steps a-c, heated to a temperature above its softening temperature.

The invention is based on the idea that a coating layer of a polymeric material on a substrate can be achieved from a pulverous polymeric material that is being heated to a temperature above its softening temperature, but preferably below its melting temperature, and thereafter is
10 brought by great force to hit the substrate. Together, the softened surface of the pulverous particles and the great force of impact result in a "sintering-like" coating of the substrate.

One advantage of the method according to the invention, is that the
15 used pulverous particles of polymeric material may be the pulverous particles as formed directly in connection with the manufacturing of the polymeric material, i.e. the pulverous form that the polymeric material has taken during its manufacturing in a reactor. Usually, the pulverous, polymeric material has a mean particle size of 1-100 μm , preferably 1-50
20 μm , and even more preferred 1-25 μm . If it is only the surface of the pulverous particles that is softened, the original properties of the polymeric material will largely be intact in the formed coating layer, which is a major advantage.

Another advantage of the method according to the invention, is that
25 it is easily controlled to enable forming of very thin coating layers, such as layers having a thickness of 0.1-5 μm , preferably 0.1-2 μm , and even more preferred 0.1-1 μm . Moreover, the method allows for forming such coating layers also on substrates that are non-uniform or are arranged in different planes, thanks to the method advantageously being contactless in relation
30 to the substrate. Furthermore, the method allows for essentially the entire surface of one side of the substrate to be coated with a homogeneous and continuous coating layer, or that the coating layer is only partially applied, on chosen parts of the surface on one side of the substrate. In the latter case, a coating layer may be formed to have a chosen pattern and/or e.g.
35 only on the parts of the substrate surface that are to be sealed against each other (in case the coating layer is a sealing layer). Besides being a sealing layer, it may for example be conceived, but not limited to, that the coating layer is an aroma barrier layer, a gas barrier layer, a gloss contributing layer, a layer for improved gripping, a scavenging layer, a

delamination layer, an adhesive layer, or a liquid barrier layer, and that the polymer is one or more polymers suitable therefore according to what is well known to the person skilled within the field.

5 BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

In the following, the present invention will be described in greater detail with reference to a preferred embodiment and with reference to the enclosed Fig. 1 that schematically and by principle shows a device according to the invention.

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DETAILED DESCRIPTION OF THE INVENTION

Detail no. 1 in Fig. 1 generally denotes mixing equipment for mixing a pulverous, polymeric material 2 with a fluid 3, in the shown case a liquid or more specifically water. Other conceivable liquids may be of the type that they affect the surface properties of the polymer particles, such as their surface tension. The polymeric material may be any type of polymeric material that is suitable to form a coating layer on a substrate, especially a packaging laminate for liquid foods, and that is insoluble in the chosen fluid. A preferred polymeric material is a polyolefin, such as a polyethylene of any suitable grade.

A suspension of polymer particles in liquid is formed in mixing equipment 1. The mixing equipment may also comprise a heating system 4 for heating the suspension, such as to 50-99 °C if the polymer is a polyolefin. The drawing symbolically shows an agitator, but any other mixing equipment is conceivable, such as a mixing equipment comprising a revolving drum.

From the mixing equipment 1, the suspension is led to pressurising equipment 5, such as a pump, in which the suspension is pressurised up to a pressure of 100 bar. Also in connection with the pressurisation, the suspension can be additionally heated, preferably by indirect heat transfer 6. As long as the polymer particles are in the liquid suspension, i.e. at least until they leave the nozzle 9 (see below), the temperature on the surface of the polymer particles should however not be brought to exceed the melting temperature of the polymer.

The increase in fluid temperature, where appropriate the water temperature, can be achieved by for example microwave equipment. By microwaves, the energy content of the water, i.e. its temperature, may be much more increased than that of the polymer granulate.

Now, the suspension is supplied to flow controlling equipment 7. The flow controlling equipment 7 is also provided with an outlet/a nozzle 9, through which the suspension is ejected/sprayed under pressure. In the shown case, the flow controlling equipment 7 is provided with a flow
5 controlling needle 8 that can be vertically displaced in the outlet, but other means for flow controlling are also conceivable, e.g. comprising vibrators.

If the entire surface of the substrate is to be coated, the open cross-section of the nozzle 9 is elongated over the width of the substrate 10. Optionally, several elongated nozzles can be arranged consecutively (not
10 shown), so that layer upon layer of the coating is formed on the substrate. If only parts of the substrate are to be coated, the nozzle will instead be of circular shape or possibly elongated but only extending over a part of the width of the substrate 10.

After the nozzle, there is a heating zone 11, in which heating
15 equipment 12 heats the suspension jet ejected from the nozzle 9, normally to a temperature above the softening temperature for the polymer but below its melting temperature. It should not be excluded however that the method according to the invention may work also if the suspension or polymer is heated to a temperature above the melting temperature of the
20 polymer, in any of the heating steps. At the heating, the liquid is evaporated from the suspension jet 16, and the polymer particles are softened, at least on their surface. Therefore, the polymer particle jet is essentially free from liquid as it hits the substrate 10. An exhaust 14 is arranged to remove evaporated liquid fumes. As the polymer particles thereafter hit the
25 substrate 10 by great force, thanks to the pressurisation of the system, a sintering-like coating 13 will be formed on the substrate, whereby the individual polymer particles are united to each other. Optionally, additional heating treatment or some other post treatment may follow (not shown), in order for the coating to acquire the desired properties.

30 The heating in the heating zone 11 is preferably direct but contactless, and makes use of controllable high power heating equipment 12, such as irradiation, laser, microwaves or similar; or some other high power technique/equipment.

Upstream and in direct connection with the coating position, the
35 substrate 10 may optionally be pretreated, preferably for increased adhesion by activation of its surface (increasing the surface energy), by e.g. flame treatment, symbolised by arrow 15. Preferably, the substrate is a substrate for a packaging laminate, preferably comprising one or more layers in the group that consists of a fibre based core layer, a polymer core

layer, a gas barrier layer (such as of aluminium or a polymeric material), an adhesive layer, a liquid barrier layer and a sealing layer.

Optionally, the surface of the polymeric pulverous particles may be affected/pretreated, e.g. to counteract agglomeration of the pulverous particles in the suspension, preferably by treating the pulverous particles or by addition to the suspension of an agent that affects the surface, such as a tenside.

The invention is not restricted to the shown embodiment but can be varied within the scope of the claims. It may for example be conceived that the liquid is initially heated and/or pressurised, before the pulverous polymer is suspended therein. If the liquid is pressurised before the heating is completed in the initial heating step(s), it is of course possible to heat to a temperature above the boiling point of the liquid, if so is desired depending on choice of polymer. If the fluid is gaseous, such as air or an inert gas, the evaporation step is of course excluded, but the heating remains with the purpose of achieving a softening of the surface of the polymer particles. The ratio of polymer/fluid may initially be 10/90 to 50/50 (%), independent of the type of fluid.

CLAIMS

1. A method of providing a substrate (10) with a coating layer (13) of a polymeric material, characterised in the steps that:
 - 5 a) a pulverous, polymeric material (2) is suspended (1) in a fluid (3),
 - b) the fluid (3) is pressurised (5),
 - c) the pressurised suspension is ejected (16) onto the substrate (10) to form the coating layer (13),
 - d) the polymeric material is, during any one of steps a)-c), heated (4, 10 6, 11) to a temperature above its softening temperature.
2. A method according to claim 1, characterised in that said heating (11) in step d) is performed during step c).
- 15 3. A method according to claim 1 or 2, characterised in that said fluid (3) is a gaseous fluid, preferably air or an inert gas.
4. A method according to claim 1 and 2, characterised in that said fluid (3) is a liquid, preferably an aqueous liquid, which liquid is
20 evaporated in connection with the heating (11) in step d), during step c), so that the polymeric material is essentially free from the fluid as it hits the substrate (10).
5. A method according to any one of the preceding claims,
25 characterised in that the heating (11) of the polymeric material during step d) is performed to a temperature below the melting temperature of the polymeric material.
6. A method according to any one of the preceding claims,
30 characterised in that the suspension is heated (4, 6) before step d), preferably in connection with step a) and/or b).
7. A method according to any one of the preceding claims,
35 characterised in that the pulverous polymeric material in step a) has a mean particle size of 1-100 μm , preferably 1-50 μm and even more preferred 1-25 μm , the pulverous particles preferably being constituted of pulverous particles as formed directly in manufacturing of the polymeric material.

8. A method according to any one of the preceding claims,
characterised in that the surface of the polymeric pulverous
particles is affected to counteract agglomeration of the pulverous
particles in the suspension, preferably by treating the pulverous
5 particles or by addition to the suspension of an agent that affects the
surface.
9. A method according to any one of the preceding claims,
characterised in that the substrate (10) is a substrate for a
10 packaging laminate, preferably comprising one or more layers in the
group that consists of a fibre based core layer, a polymer core layer,
a gas barrier layer, an adhesive layer, a liquid barrier layer and a
sealing layer.
10. A method according to any one of the preceding claims,
15 characterised in that the substrate (10) is pretreated,
preferably in direct connection with step c), (15) for increased
adhesion of the polymeric material.
11. A method according to any one of the preceding claims,
20 characterised in that said coating layer (13) is applied at a
thickness of 0.1-5 μm , preferably 0.1-2 μm and even more preferred
0.1-1 μm .
12. A method according to any one of the preceding claims,
25 characterised in that said coating layer (13) is applied on
essentially the entire surface of one side of the substrate (10).
13. A method according to any one of the preceding claims,
30 characterised in that said coating layer (13) is applied only
partially, on chosen parts of the surface of one side of the substrate
(10).
14. A device for providing a substrate (10) with a coating layer (13) of a
35 polymeric material, characterised in that it comprises
- mixing equipment (1), arranged to suspend a pulverous polymeric
material (2) in a fluid (3),
- pressurising equipment (5), arranged to pressurise said fluid,
- at least one nozzle (9) operatively connected to the pressurising

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equipment (5) and arranged to eject (16) the suspension of polymeric material in fluid towards the substrate (10),
- heating equipment (4, 6, 11) arranged to heat the polymeric material to a temperature above its softening temperature.

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15. A device according to claim 14, characterised in that heating equipment (4, 6) is arranged upstream the heating equipment (11), preferably in connection with said mixing equipment (1) and/or said pressurising equipment (5), and arranged to heat said fluid and/or suspension of polymeric material in fluid.

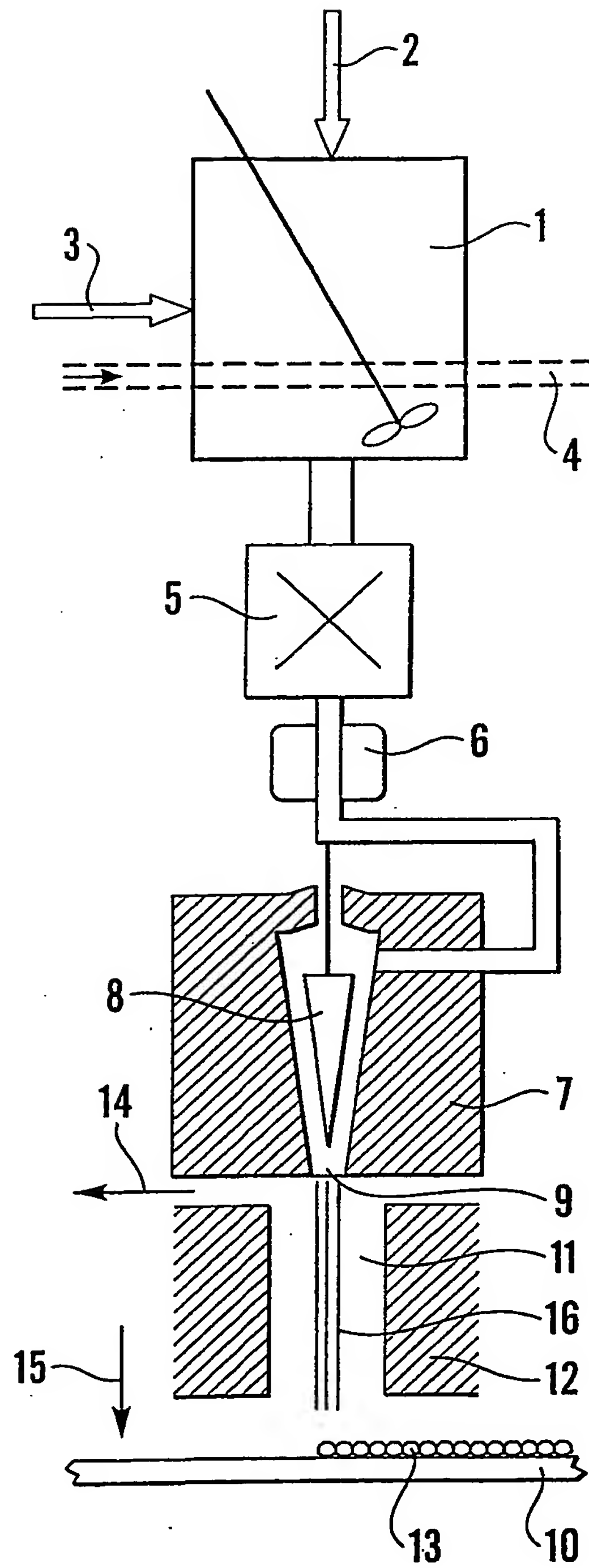
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16. A device according to claim 14 or 15, characterised in that flow controlling equipment (7, 8) is arranged to control a flow (16) of the suspension in said nozzle (9).

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17. A device according to any one of claims 14-16, characterised in means (15) arranged to pretreat the substrate (10), preferably comprising activation of the surface of the substrate.

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**Fig. 1**

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 2004/001695

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B05D 1/02, D21H 23/50
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B05D, D21H, B29C, B29D, B32B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 1226409 A (NIPPON TELEGRAPH AND TELEPHONE PUBLIC CORPORATION), 31 March 1971 (31.03.1971), page 1, line 13 - line 25; page 1, line 52 - line 85; page 2, line 20 - line 36, page 2, line 56 - line 94; figure 1; claims 1-8 --	1-17
A	WO 9736049 A1 (DSM N.V. ET AL), 2 October 1997 (02.10.1997), claims 1-15, abstract --	1-17
A	EP 0437721 A1 (DAIKIN INDUSTRIES, LIMITED), 24 July 1991 (24.07.1991), figures 1,2, claims 1-7, abstract --	1-17



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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 "O" document referring to an oral disclosure, use, exhibition or other means
 "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 2004/001695

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0316571 A2 (TEIJIN LIMITED), 24 May 1989 (24.05.1989), page 3, line 38 - line 40, claims 1-6, abstract ----- --	1-17

INTERNATIONAL SEARCH REPORT
Information on patent family members

30/01/2005

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